3

SUPPLEMENTARY NOTES

TO THE FIRST AND SECOND EDITION OF

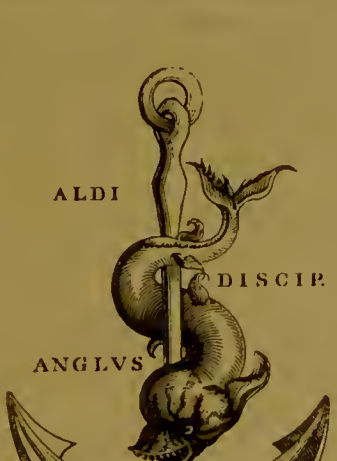
DR. BUCKLAND'S

BRIDGEWATER TREATISE

WITH A

PLATE OF THE FOSSIL HEAD AND RESTORED

FIGURE OF THE DINOTHERIUM



LONDON

WILLIAM PICKERING

1837

NOTICE.

Some important discoveries having been made, whilst the Second Edition of this Treatise was passing through the press, the author has thought it better to give some notice of them in the form of Supplementary Notes, than to disturb the order of the pages, or places of the notes, from those in which they stood in the First Edition. These Supplementary Notes, with an additional plate of the head and restored figure of the Dinotherium, are reprinted in a form accessible to those purchasers of the First Edition, who may wish to append them to their volumes.

Oxford, March 25.
1837.

C. WHITTINGHAM, TOOKS COURT, CHANCERY LANE.

SUPPLEMENTARY NOTES.

P. 33. Since the publication of my first edition, I have been favoured by the Rev. G. S. Faber with a communication of his opinion respecting the views propounded in my second Chapter, on the Consistency of Geological discoveries with Sacred History, and am much gratified by his permission to state, that he is satisfied my views upon this subject are consistent with a critical interpretation of the Hebrew text of those verses in Genesis, with which they may at first sight appear to be at variance.

This opinion of Mr. Faber is enhanced in value, by his adopting it to the exclusion of a different opinion published in his Treatise on the Three Dispensations, (1824), in which it was attempted to reconcile Geological Phenomena with the Mosaic History, by supposing each of the demiurgic days to be periods of many thousand years.

Respecting this subject, I have been much surprised to find myself misrepresented, as inclining to the opinion that each day of the creation, recorded in the Mosaic Narrative, comprehended a space of many thousand years. In my second Chapter (P. 17 et seq.) I have stated that this opinion has been entertained, both by learned Theologians and by Geologists, but is not entirely supported by Geological facts, and have adopted the hypothesis which supposes an undefined amount of time to have elapsed between the creation of the matter of the Universe, and that of the Human race. According to this view, placing *the Beginning* at an indefinite distance before the first of the six days described in the Mosaic History of creation, I see no reason for extending the length of any of these beyond a natural day; and I suppose that an interval sufficient to afford all the time required by the Phenomena of Geology, elapsed between the prior creation of the Universe recorded in the first verse

of Genesis, and that later creation, of which an account is given in the third and following verses, and which has especial relation to the preparation of the Earth for the abode of man. At p. 24, it is shewn in a Note by Prof. Pusey, that the notion of such a *prior act of creation* was entertained by many of the Fathers of the Church, and also by Luther.

P. 41. Professor Kersten has found distinctly formed crystals of prismatic Felspar on the walls of a furnace in which Copper slate and Copper Ores had been melted. Among these *pyrochemically* formed crystals, some were simple, others twin. They are composed of Silica, Alumina, and Potash. This discovery is very important, in a geological point of view, from its bearing on the theory of the igneous origin of crystalline rocks, in which Felspar is usually so large an ingredient. Hitherto every attempt to make felspar crystals by artificial means has failed. See Poggendorf's Annalen, No. 22, 1834, and Jameson's Edin. New Phil. Journal.

Professor Mitscherlich has also succeeded in producing synthetically, by the action of Heat, artificial crystals of Mica; these are difficult to make, unless the ingredients pass very slowly from a fluid to a solid state; as they are supposed to have done, in an infinitely greater degree, in the formation of Granite, and other Primary Rocks, of which Mica forms a large ingredient. In more recent igneous rocks of the Trap formation, in which Mica is rare, and crystals of Pyroxene abound, it is probable that the cooling process was much more rapid, than in rocks of the Granitic series; and crystals of Pyroxene have been formed synthetically by Mitscherlich, from their melted elements, under much more rapid cooling than is required to produce artificial Mica.

The experiments of Sir James Hall, on whinstone and lava, made in 1798, first shewed the effects of slow and gradual cooling in reproducing bodies of this kind in a crystalline state. Similar experiments were repeated on a larger scale, by Mr. Gregory Watt, in 1804. Sir James Hall's experiments on reproducing artificial limestone and crystalline marble, were made in 1805.

Mr. Whewell, in his Report on Mineralogy to the British Asso-

ciation at Oxford, 1832, refers to observations of Dr. Wollaston and Professor Miller on crystals of Titanium, and Olivine, found in the slag of Iron furnaces; and to the experiments of Mitscherlich and Berthier on artificial crystals, similar to those found in Nature, obtained by them in the furnace by direct synthesis, regulated by the Atomic Theory. With respect also to artificial crystals obtained in the humid way, he refers to the observations and experiments on artificial salts, by Brooke, Haidenger, and Beudant, and to the experiments of Haldat, Becquerel, and Repetti.

At the meeting of the British Association at Bristol, August, 1836, Mr. Crosse communicated the results of his experiments in making artificial crystals by means of long continued galvanic action, of low intensity, produced by water batteries on humid solutions of the elements of various crystalline bodies that occur in the mineral kingdom; and stated, that he had in this way obtained artificial crystals of Quartz, Arragonite, Carbonates of Lime, Lead, and Copper, and more than 20 other artificial minerals. One regularly shaped crystal of Quartz, measuring $\frac{3}{16}$ of an inch in length, and $\frac{1}{16}$ in diameter, and readily scratching glass, was formed from fluo-silicic acid exposed to the electric action of a water battery from the 8th of March to the latter end of June, 1836.

P. 65, *Note.* In the note respecting the Fresh water shells which occur in the upper region of the great Coal formation, I have omitted to refer to an important discovery of Mr. Murchison, (1831-32), who has traced a peculiar band of limestone, charged with the remains of Fresh water animals, e.g. Paludina, Cyclas, and microscopic Planorboid shells, interposed between the upper Coal measures, from the edge of the Breiddin hills, on the N. W. of Shrewsbury, to the banks of the Severn, near Bridgnorth, a distance of about thirty miles; and has further shewn that the Coal measures, containing this "lacustrine" limestone, pass upwards conformably into the Lower New Red Sandstone of the central counties. (See Proceedings Geol. Soc. V. i. p. 472.) The chief localities of the Shropshire limestone are Pontesbury, Uffington, Le Botwood, and Tasley.

Beds of limestone, occupying a similar geological position, and containing the same organic remains, (some of which belong to the well known deposit at Burdie House, near Edinburgh), have more recently been recognized at Ardwick, near Manchester; these beds were identified with those of Shropshire, by Professor Phillips (Brit. Assoc. Adv. of Science, 1836), and have also been described by Mr. Williamson, Phil. Mag. October, 1836.

P. 75, *Note*, and 491, *Note*. The Coal of Bückeberg, in Nassau, respecting which various opinions have been entertained, some referring it to the Green sand, and others to the Oolite series, has been determined by Prof. Hoffmann to belong to the Wealden Fresh-water formation.

See Roemer's Versteinerungen des Norddeutschen Oolithen Gebirges. Hanover, 1836.

P. 88. An account has recently been received from India of the discovery of an unknown and very curious fossil ruminating animal, nearly as large as an Elephant, which supplies a new and important link in the Order of Mammalia, between the Ruminantia and Pachydermata. A detailed description of this animal has been published by Dr. Falconer and Captain Cautley, who have given it the name of Sivatherium, from the Sivalic or Sub-Himalayan range of hills in which it was found, between the Jumna and the Ganges. In size it exceeded the largest Rhinoceros. The head has been discovered nearly entire. The front of the skull is remarkably wide, and retains the bony cores of two short thick and straight horns, similar in position to those of the four horned Antelope of Hindostan. The nasal bones are salient in a degree without example among Ruminants, exceeding in this respect those of the Rhinoceros, Tapir, and Palæotherium, the only herbivorous animals that have this sort of structure. Hence there is no doubt that the Sivatherium was invested with a trunk, and probably this organ had an intermediate character between the trunk of the Tapir and that of the Elephant. Its jaw is twice as large as that of a Buffalo, and larger than that of a Rhinoceros. The remains of the Sivatherium were accompanied by those of the Elephant, Mastodon, Rhinoceros, Hippopotamus, several Ruminantia, &c.

We have seen (p. 87) that there is a wider distance between the living Genera of the Order Pachydermata than between those of any other Order of Mammalia, and that many intervals in the series of these animals have been filled up by extinct Genera and Species, discovered in strata of the Tertiary series. The Sivatherium forms an important addition to the extinct Genera of this intermediate and connecting character. The value of such links with reference to considerations in Natural Theology has been already alluded to, p. 114.

P. 91. Further light has recently been thrown on the history of the organic remains of the Miocene system of the Tertiary deposits, by an account of discoveries made in strata of this formation in the South of France, near the base of the Pyrenees. On the 16th of January, 1837, a Memoir was presented to the Academy of Sciences at Paris, by M. Lartet, respecting a prodigious number of fossil bones that have been lately found in the tertiary fresh-water formation, of Simorre, Sansan, &c., in the department of Gers. Among these remains are bones of more than 30 species, referrible to nearly all the orders of Mammalia. The most remarkable among them is the lower jaw of an Ape, which presents the first fossil type of the order Quadrumana yet discovered. The individual from which this jaw was derived, was probably about 30 inches high.

The following is a List of the Genera under which these fossil remains are comprehended.

Quadrumana. *Simia*, one species.

Pachydermata. *Dinotherium*, two species. *Mastodon*, five species. *Rhinoceros*, three species. One new animal allied to Rhinoceros. *Palæotherium*, one species. *Anoplotherium*, one species. One extinct species allied to *Anthracotherium*. One extinct species allied to *Sus*.

Carnivora. *Canis*, one species. *A new Genus*, between a Dog and a Raccoon, one large species. *Felis*, one large species. *Genetta*, animal allied to. *Coati*, animal allied to Coati, large as a White Bear.

Rodentia. *Lepus*, one small species. Many other small species of Rodents not yet determined.

Ruminantia. *Bos*, one species. *Antilope*, one species. *Cervus*, several species.

Edentata. One large unknown species.

M. de Blainville, who is about to publish an account of these remains, points out their importance in illustrating the ancient Zoology of France, since, in a single locality, which was formerly a Basin, receiving an abundance of alluvial waters, we find confusedly mixed together in a Tertiary fresh-water formation, scattered and broken bones and fragments of skeletons of a large proportion of the fossil Quadrupeds which are found dispersed over the Tertiary strata of the rest of France, and derived from genera of almost all the orders of Mammalia.—*Comptes rendus, No.* 3. *Jan.* 16, 1837. These remains appear to be of the same age with those at Epplesheim.

P. 106. In September, 1835, the author saw at Liège the very extensive collection of fossil Bones made by M. Schmerling in the caverns of that neighbourhood, and visited some of the places where they were found. Many of these bones appear to have been brought together like those in the cave of Kirkdale, by the agency of Hyænas, and have evidently been gnawed by these animals; others, particularly those of Bears, are not broken, or gnawed, but were probably collected in the same manner as the bones of Bears in the cave of Gailenreuth, by the retreat of these animals into the recesses of caverns on the approach of death; some may have been introduced by the action of water.

The human bones found in these caverns are in a state of less decay than those of the extinct species of beasts; they are accompanied by rude flint knives and other instruments of flint and bone, and are probably derived from uncivilized tribes that inhabited the caves. Some of the human bones may also be the remains of individuals who, in more recent times, have been buried in such convenient repositories. M. Schmerling, in his Recherches sur les Ossemens Fossiles des Cavernes de Liège, expresses his opinion that these human bones are coeval with those of the quadrupeds, of extinct species, found with them; an opinion from which the Author, after a careful examination of M. Schmerling's collection, entirely dissents.

P. 135. The Dinotherium has been spoken of as the largest of terrestrial Mammalia, and as presenting in its lower Jaw and Tusks a disposition of an extraordinary kind, adapted to the peculiar habits of a gigantic herbivorous aquatic Quadruped. In the autumn of 1836 an entire head of this animal was discovered at Epplesheim, measuring about four feet in length and three feet in breadth; Professor Kaup and Dr. Klipstein have recently published a description and figures of this head, (see Pl. 2′, Fig. 2.) in which they state that the very remarkable form and dispositions of the hinder part of the skull, shew it to have been connected with muscles of extraordinary power, to give that kind of movement to the head which would admit of the peculiar action of the tusks in digging into and tearing up the earth. They further observe, that my conjectures (P. 138) respecting the aquatic habits of this animal, are confirmed by approximations in the form of the occipital bone to the occiput of Cetacea; the Dinotherium, in this structure, affording a new and important link between the Cetacea and Pachydermata. More than 30 species of fossil Mammalia have now been found at Epplesheim.

P. 164. Mr. C. Darwin has deposited in the Museum of the Royal College of Surgeons, London, a most interesting series of fossil bones of extinct Mammalia, discovered by him in South America. I learn from Mr. Owen "that these include two, if not three distinct species of Edentata, intermediate in size, between the Megatherium and the largest living species of Armadillo (*Dasypus Gigas*, Cuv.), all similarly protected by an armour of bony tubercles, and making the transition from the Megatherium more directly to the existing Armadillos, than to the Sloths. A still more interesting fossil, is the cranium of a quadruped, which must have rivalled the Hippopotamus in dimensions, but which has the dentition of an animal of the Rodent Order; and it is worthy of remark, that the largest living species of that order, the Capybara, is peculiar to South America. Mr. Darwin has also collected fragments of a small Rodent, closely allied to the Agouti; and the remains of an Ungulate quadruped, of the size of a Camel; and which forms a link between the aberrant group of Ruminantia to which the Camels and Llamas belong, and the order Pachydermata."

P. 198. In the summer of 1836, Mr. Murchison discovered at Ludlow, in the sandy slate rocks that form the upper members of the Silurian System, a very curious Bed, from one to five or six inches thick, almost entirely composed of dislocated bones, teeth, and scales of Fishes, intermixed with numerous small coprolites. In all these circumstances of its organic remains, this bed resembles the stratum called *the bone bed*, at the bottom of the Lias on the banks of the Severn, near Aust Passage, and near Watchet, which is similarly loaded with bones, teeth, and coprolites derived from Fishes, and with dislocated bones of Reptiles. This Ludlow Bone bed affords the first example yet noticed, of remains which prove the abundant existence of Fishes in that early period of the Transition series, when the upper strata of the Silurian system were deposited.

The occurrence of teeth, scales, bones, and coprolites derived from Fishes, in strata of the Carboniferous system, is noticed at p. 275, and p. 276, Note.

P. 208. The opinion that the colour of the skin of the Chameleon was varied by the varied intensity of its inspirations, has been recently disproved by Dr. Milne Edwards, who has shewn that this variation is produced by changes in the disposition of layers of differently coloured membranous pigments, placed one above another under the cuticle, and capable of such changes that one may sometimes hide the other. Hence it follows that the conjecture of Cuvier is not verified, which attributed to the Plesiosaurus the possibility of its having been able to change the colour of its skin, in consequence of the resemblance in the structure of its ribs to that of the ribs of the Chameleon.

See Penny Cyclopædia, Vol. VI. p. 474, et seq.

P. 214. A remarkable exemplification of the exquisite Power of the human hand has been communicated to me by Mr. James Gardener, of Regent Street, London, from whom I learn that he has with his own hand, aided by the sense of touch alone, and with his eyes shut, ruled parallel lines, which being examined with a micrometer, were found to be at the exact distance of $\frac{1}{2,550}$ of an inch from one another. With his unarmed eye he cannot

distinctly see lines that are more distant from one another than $\frac{1}{312}$ of an inch. In this case the sense of touch is more acute than that of sight in the ratio of 8 to 1. Mr. Gardener is also able, without the assistance of any instrument, to draw a perfect circle or a perfect ellipse, moving his hand on the wrist as a centre.

P. 296. "The *senses* of Conchifers must be very confined; and indeed there is no good ground for attributing to the generality of them any thing beyond a sense of touch and taste. That most of them may be conscious of the presence or absence of light is possible. "Not having any especial organs for seeing, hearing, or smelling," says Sir Anthony Carlisle, speaking of the common oyster in his Hunterian Oration (1826), "the creature is limited to perceive no other impressions but those of immediate contact; and yet every part of its exterior seems to be sensible to light, sounds, odours, and liquid stimulants. It is asserted by fishermen, that oysters, in confined beds, may be seen, if the water is clear, to close their shells whenever the shadow of a boat passes over them."

"M. Deshayes goes so far as to say that no especial organ of sense can be detected among them, unless, perhaps, those of touch and taste; but we must not forget what have been called the eye-specks in the Pecten, to the animal of which Poli gave the name of Argus, from the supposed number of its visual organs. The pectens are free swimmers, and, from their rapid and desultory motions, we have heard them termed the butterflies of the ocean. The manner in which these motions are executed, especially on the approach of danger, indicates the possession of a sense analogous, at least, to that of ordinary vision. These eye-specks may be seen in the Pecten, placed at short intervals round the thickened edge of the mantle, on the outworks, as it were, of the internal part of the animal fabric. 'As locomotion so vision' is a general aphorism not without its particular exception; for there is good reason for believing that *Spondylus*, which is a fixture in its adult state, is furnished with these visual specks." (*Penny Cyclopædia*, vol. vii. p. 432, *et seq. Article Conchifera.*) Ehrenberg has described the eyes of the Medusa aurita to be in the form of minute red points on the circumference of the disk. He

has also ascertained the existence of small red eye-specks at the extremity of the rays of the Asterias.

P. 328. The *specific gravity* of a body, is its weight, compared with the weight of another body, whose magnitude is the same; hence, if a body which occupies any given space in water be contracted into a smaller magnitude, whilst its absolute weight remains the same, it becomes specifically heavier. Supposing the absolute weight of the body of the Nautilus, and also that of its pericardial fluid, to be the same as that of an equal bulk of water, the body, when immersed, would always displace a quantity of water, equal to its bulk. The presence of the pericardial fluid within the body, (i. e. within the Pericardium), or its removal from it into the shell, would not affect the specific gravity of the body, because *the magnitude of the body varies* according as the pericardium is either empty, or distended with its peculiar fluid. But, as *the magnitude of the shell is constantly the same*, whilst the quantity of matter within it varies, as the pericardial fluid enters or leaves the siphuncle, its specific gravity is varied accordingly, being increased, when the fluid enters the siphuncle (compressing the air within the air-chambers), and diminished, when this fluid returns from the siphuncle into the body.

When the animal, preparing to rise, emerges from its shell, and the pericardial fluid, returning from the siphuncle into the pericardial sac, enlarges the body by the distension of this sac, the absolute weight of the body and shell together remains the same, but the specific gravity of the whole is diminished by this increase of the bulk of the body, and the animal floats. When preparing to sink, it shrinks back into its shell, and compressing the pericardial sac, forces its contents into the siphuncle, the bulk of the body is diminished by the collapse of this sac to an amount equal to the difference between the bulk of the distended and contracted sac, the whole becomes specifically heavier, and the animal sinks.

For the sake of simplifying the problem we have supposed the specific gravities both of the pericardial fluid, and of the body of the animal, to be the same as that of water. If, as Mr.

Owen affirms, the pericardial fluid is more dense than water, its transfer into the siphuncle will be more efficacious in causing the shell to sink, because a fluid, whose specific gravity is greater than that of an equal bulk of water, is added to the shell, without increasing its magnitude; but when the same fluid returns into the body, the consequent addition to the specific gravity of the body, is only the *difference* between the specific gravity of this fluid and that of water; and this is more than counterbalanced by the *diminution of specific gravity* which the body undergoes from the expansion of the retractile tentacula, and consequent enlargement of their magnitude. The same tentacula, when the animal shrinks back into its shell, are contracted into a smaller magnitude, and increase the tendency of the shell to sink.

In the Water balloon and apparatus connected with it, referred to at p. 318 and p. 327, the tall glass, and membrane which covers it, represent the Pericardium of the Nautilus; the water which fills the glass acts like the pericardial fluid, and if a small empty bladder were attached to the neck of the Balloon, and suspended, like an artificial siphuncle, within its cavity, the bladder, when filled with water, would represent the siphuncle of the Nautilus, when filled with pericardial fluid; and the air within the chamber of the Balloon, would represent that within the chambers of the Nautilus.

The difference would be, that in the case of the Nautilus, the *entire* Pericardium is a flexible membrane, and that nearly the *whole* of the pericardial fluid may be forced into the siphuncle; whilst in the water Balloon, *the membrane only* at the top of the glass is flexible, and a *small part* only of the water in the glass can be forced into the Balloon.

The principle which causes a change in the specific gravity, by varying the quantity of matter, within the shell and within the Balloon, without varying their respective magnitudes, is the same.

P. 329 *. The Tentacula which when expanded around the head, would impede any *progressive* motion of the animal, would follow the *retrograde* body and shell, without causing any

material retardation. The part of the shell also which is foremost in all the retrograde movements of the animal, in the act of ascending and descending, and also in swimming at the surface, is that which receives the least resistance from the fluid through which it moves, and at the same time presents the strongest part or back of the shell to any body against which it may strike, either when floating on the surface, or on arriving at the bottom of the sea.

P. 331. Mr. Owen observes, that the Hood, or flattened muscular disk of the Nautilus Pompilius, seems calculated to act as the chief locomotive organ in creeping at the bottom; and in the supine position of the animal, bears considerable analogy to the foot of a Gasteropod; in a state of rest and retraction it would serve, like an operculum, as a rigid defence at the outlet of the shell. (*See Owen on the Pearly Nautilus*, p. 12.) The animal may also assist its movements along, and adhesion to the bottom, by some of its numerous tentacula.

P. 332 †. In the case of animals possessing a siphuncle and chambered shell, but having no means to fill the siphuncle with pericardial fluid, the admission and abstraction of any other secreted fluid, or of water, to and from the siphuncle, would have a similar effect to that of the pericardial fluid of the Nautilus, in varying the specific gravity. It may perhaps be shewn hereafter, that in some of these genera an organization exists fitted to fill and empty the siphuncle by other agency than that of the Pericardium, and possibly with water admitted from the branchial cavity; but as we know that the Nautilus Pompilius possesses in its pericardial fluid and siphuncle a sufficient apparatus to effect this purpose, and thereby to cause the rising and sinking of this animal; and as we find in the Ammonites and many extinct families of fossil chambered shells, a siphuncle and air chambers, very similar to those of the Nautilus; we may infer from analogy, that mechanisms so similar, as to those parts which have escaped destruction, were connected with soft and perishable parts, corresponding with the pericardial apparatus in the living Nautilus.

It is of little importance, however, to the statical theory of

siphuncular action here proposed, whether the fluid alternately admitted to and rejected from the siphuncle be derived from the Pericardium, or from any other source within the body, or even from the sea; in the former case, we have ascertained the existence of a mechanism whereby the movements of the pericardial fluid may be effected, as in the Nautilus Pompilius; in the latter cases the mechanism for adjusting the passage of the fluid to and from the siphuncle remains yet to be discovered.

In the case of siphons which are surrounded by unyielding rigid shell throughout their whole extent, (as in the Nautilus Sypho,) the elasticity of the air within the chambers cannot aid the muscular power of the siphuncle, in regulating the action of any fluid within that tube; and if the hypothesis suggested (P. 359, Note l. 9.) respecting this species should be inapplicable to it, and to other animals which have an inflexible shell around the siphuncle, their method of moving the fluid to and from this organ is yet unknown.

In the case of jointed sheaths like those at Pl. 32, Fig. 3, *d*, *e*, *f*, and Pl. 33, each calcareous joint (*e*,) if composed of rigid shell, may have articulated with the collars of the adjacent transverse plates (*h*, *i*,) so as to form a moveable collar valve, of which the superior margin being raised a little on the *outside* of the upper collar (*h*,) would leave an opening between the lower margin of the valve and the *inside* of the subjacent collar (*i*); through this opening air might pass from the contiguous air chamber into the space between the calcareous sheath and membranous siphon, as often as it was emptied of its pericardial fluid, and when this fluid filled the siphon, the air might return by the same passage into the air chamber, and the lower margin of the valve fall into its socket within the lower collar (*i*).

It is possible that in the Spirula and other animals that do not withdraw their bodies into the shell, the only function of the air chambers may be to counterbalance the weight of the body, and give it buoyancy; in such cases the use of the siphuncle may be to carry down to the extremity of the shell, and send off into each air chamber, vessels necessary to maintain the vitality of the interior of the shell, and of the transverse septa. The mode of ascent and descent ascribed to the Nautilus Pompilius is inap-

plicable to such animals, and their movements are probably effected by muscular exertion only.

P. 412, l. 12. Mr. Murchison in his excellent memoir on a fossil Fox found in the Tertiary Fresh-water Formation at Œningen, near Constance, gives a list of many genera of fossil Insects as well as of Crustacea, Fishes, Reptiles, Birds, and Mammalia, discovered in the slaty marl and lime-stone of these very interesting Quarries. See Geol. Trans. Lond. N. S. V. III. p. 277.

P. 412, Note. The collection of fossil Insects from Aix described in the paper here referred to, was made by Mr. Lyell in conjunction with Mr. Murchison. In the same paper is noticed the preservation of the pubescence on the head of one of the Diptera. See Ed. New Phil. Journ. Oct. 1829, P. 294, Pl. 6, Fig. 12.

P. 446. In the concluding note of my first edition, I mentioned Ehrenberg's discoveries of the silicified remains of fossil Infusoria in the Tripoli, or polishing slate, (Polierschiefer Werner), from Bilin in Bohemia, and from four other localities, and also his discovery of similar remains in the slimy Iron Ore of certain marshes. I am now enabled to extract further information from his memoirs upon this subject, presented to the Royal Academy of Berlin, in June and July 1836, and translated in Taylor's Scientific Memoirs, February 1837.

It is stated in this memoir, that the mineral springs of Carlsbad contain living species of Infusoria, of the same kind that occur in sea water, near Havre in France, and near Wismar on the Baltic; and also that a kind of siliceous paste called Kieselguhr, found in nests of the size of a man's fist or head, in a Peat Bog at Franzenbad, near Eger, consists almost entirely of minute siliceous shields of a species of Navicula, N. viridis, which is now living in fresh-water, near Berlin, and widely diffused elsewhere. The remains of Infusoria also almost entirely compose the Kieselguhr of the Isle of France, and a similar substance called Bergmehl, from San Fiore, in Tuscany. Nine existing species have been recognized in the Kieselguhr of Franzenbad; in that of the Isle of France five species; in the Bregmehl of San Fiore nineteen species; in the Polierschiefer of Bilin four species.

In each of these cases, the greater number of the species are the same that now live in stagnant fresh-water; some inhabit saline mineral waters, and a few live in the sea. The total number of fossil species observed is twenty-eight, fourteen of which agree with living fresh-water species of Infusoria, and five with living marine species. The other nine probably belong to living species not yet discovered. In each of these four localities one species preponderates largely over the rest, and in no two cases is it the same species. The Polierschiefer of Bilin occupies a surface of great extent, probably the site of an ancient lake, and forms slaty strata of fourteen feet in thickness, consisting almost entirely of an aggregation of the siliceous shields of *Gaillonella Distans*. The size of one of these is about $\frac{1}{288}$ of a line which is about $\frac{1}{6}$ of the thickness of a human hair, and nearly of the size of a globule of the human blood; about twenty-three millions of animals are contained in a cubic line of the Polierschiefer, and 41,000 millions in a cubic inch; a cubic inch of Polierschiefer weighs 220 grains, of the 41,000 millions of animals, 187 millions go to a grain, or the siliceous shield of each animalcule weighs about the $\frac{1}{187}$ millionth part of a grain. Siliceous remains of Infusoria have recently been found also in the Polierschiefer of Planitz and Cassel.

M. de Humboldt has recently communicated to the Academy of sciences at Paris (February 20, 1837) a letter from Professor Retzius of Stockholm, in which he informs Ehrenberg that a substance called Bergmehl, (*Farine de montagne*,) analyzed and described by Berzelius, 1833, and found by him to contain Silex, animal matter, and crenic acid, is eaten in Lapland in seasons of scarcity, mixed with ground corn and bark, in the form of bread; in 1833 this occurred in the Commune of Degerfors. M. Retzius has discovered in this Bergmehl, nineteen species of Infusoria with siliceous shields. This deposit appears to be analogous to the Kieselguhr of Franzenbad.

L'Institut, 22 Feb. 1837. No. 198.

Ehrenberg has further ascertained that a soft yellow ochreous substance called Raseneisen, (Marsh Ochre, or Meadow Earth,) which is found in large quantities every spring in Marshes about Berlin, covering the bottom of ditches, and in the footsteps of ani-

mals, is composed in part of Iron secreted by Infusorial animalcules of the Genus Gaillonella. This Iron may be separated from the siliceous shields of these animals, which retain their form after the extraction of the Iron. He has also detected similar ferruginous and siliceous remains of Infusoria in similar ochreous substances, from the Ural, and New York, and also in a yellow earthy substance formed on the surface of the mineral water of the salt works at Colberg and Dürrenberg. This substance is used for iron colour in house painting at Colberg. The iron secreted by these animalcules, and connected with their siliceous shields, forms after death a nucleus to which other iron is attracted, from a solution of this metal in the water which these animals inhabit.

In another communication, Prof. Ehrenberg announces that certain indurated and heavy portions of the Polierschiefer of Bilin, called Saugschiefer, are also the remains of Gaillonellæ, cemented and filled with amorphous siliceous matter derived from these infusoria; and that nodules of Semiopal, which occur in the same Polierschiefer, are also composed of Silex derived from infusorial remains that have been dissolved and formed into siliceous concretions, having dispersed through them numbers of infusorial shields, partially dissolved, together with others that are unaltered. Ehrenberg also thinks he has found indications of microscopic organic bodies of a spherical form, (some, perhaps, allied to the existing genus Pyxidicula,) in semi-opal from Champigny, and also in semi-opal from the Dolerite of Steinheim near Hanau, and from the Serpentine of Kosemitz in Silesia, and in precious opal from the Porphyry of Kaschau. In the white and opake bands of a few chalk flints, he has also found spherical and needle-shaped microscopic bodies, which he considers to be of organic origin; these are most abundant in the white siliceous crust which forms the exterior of the flints, and in the mealy siliceous powder sometimes found within their cavities, but are not distinguishable in the black interior of the nodule. The existence of living marine species of Infusoria, renders it probable that animals of this class existed also in the early seas in which the stratified rocks were deposited. The fact that living Infusoria have the power of secreting Silex and Iron, places their fossil siliceous and ferruginous remains, nearly

in the same category with the fossil calcareous exuviæ of Foraminifers, Polypes and Crustaceans.

The living species of these animalcules, which are now beginning to be found so abundantly in a fossil state, are divided into two classes and six families; three of these families have a naked flexible epidermis, and three, a siliceous epidermis, forming a transparent shell, or cuirass. The cuirass, in the greater number of species, is composed of two siliceous valves, the univalve cuirass has the shape of a leaf, with its edges rolled inwards towards each other. About one half of Ehrenberg's genera of Infusoria, have a siliceous cuirass, and the other half, a membranous covering.

The species found at Carlsbad do not live in the rising thermal water, but are seen at a small distance from the spring, covering the stones and wood with a green slimy substance, chiefly composed of the bodies of millions of Infusoria. These animalcules are never found in the rising water of a hot spring, nor in the limpid water of a cold spring, river, or well.

P. 448, Note. Mr. Searles Wood has discovered fifty species of foraminifers in the lower Crag formation of Suffolk.

Lond. and Edin. Phil. Mag. Aug. 1835. p. 86.

P. 495, l. 4. Mr. Webster was the first who noticed in the I. of Portland the interesting Phenomena of the Bed of black vegetable mould called the *Dirt Bed*, with its fossil wood, pebbles, &c. and ascertained that the silicified Trees found in this island had been obtained from this bed only, and not from the Portland Oolite. Geol. Trans. Lond. N. S. Vol. II. p. 42. He also states that the Purbeck series contains strata of *Fresh-water* origin, and is thus distinguished from the Portland Oolite, which contains *marine* shells only. In the Paper referred to, he hesitates where to draw the exact line of separation between these two formations, but is inclined to place it at the *Chert Bed*, (See Pl. 57, Fig. 1.) an opinion which he still maintains. In the same Paper he considers the Dirt Bed not to rest immediately upon a stratum of marine formation, (as Mr. De la Beche and myself have subsequently and erroneously supposed it to do; Geol. Trans. N. S.

Vol. IV. p. 15.) but that the Beds called *Top Cap*, immediately beneath the Dirt Bed (see Pl. 57, Fig. 1.) are of Fresh water origin. Beneath this Top Cap, two other seams of black earth of very small extent and thickness, one about five feet and the other seven feet below the Dirt Bed, were discovered in 1832, by Prof. Henslow, (Geol. Trans. N. S. Vol. IV. p. 16), and in the uppermost of these Dr. Fitton has since found trunks of Cycadites, in the position which they would have occupied if they had grown there. (See Geol. Trans. N. S. V. iv. p. 219.)

P. 499. In the course of the last year, Mr. Robert Brown has ascertained by examination of a Trunk of *Cycadites microphyllus*, from Portland, the existence of scalariform vessels without discs, in the mature Trunk; a point in which, he informs me, these fossils agree with the American portion of the order *Cycadeæ*, though, in other respects, they bear a greater resemblance to the African and Australian species. Mr: Brown observes further, "that the order *Cycadeæ* presents but one genus in America, namely, the *Zamia*, on which this genus was originally founded, and to which it has been recently restricted; and that the coincidence in the structure of the scalariform vessels in the trunk of this Zamia of the New World, with that of the fossil Cycadites of Europe, is very remarkable.

P. 519. Note, l. 16. Since the Publication of my first Edition, I have been favoured with the following communication from Mr. Bowerbank, respecting the fossil remains of vegetables found in the London Clay. "I have, in my collection of fossil fruits from the London Clay, more than 25,000 specimens. The species I have already determined exceed 500 in number, and I have no doubt that several hundred more may be estimated at the true number in my collection. The late Mr. Crow informed me that he was acquainted with between 6 and 700 species. None of these fruits can be with certainty referred to any recent species, although the approximation is in many instances very close. Palmaceous fruits are abundant, and many other fruits agreeing not only in external form, but in internal structure with well known classes of seed-vessels of the present period; along

with these there are some which I have not as yet been able to refer to any known form of fruit. Coniferous fruits are comparatively scarce, although the remains of Coniferous branches are by no means uncommon. A similar discrepancy exists as regards the Palms, stems of palmaceous structure being rarely found, although the species of fruits of that order are numerous. The principal bulk of fossilized woods found in the London Clay are decidedly Dicotyledonous, and the great bulk of fossil fruits likewise. The internal structure of both fruits and woods is preserved in a most perfect and beautiful manner."

P. 552. At the meeting of the British Association at Bristol, in August, 1836, Mr. R. W. Fox submitted to the Geological Section an experiment, showing that the native yellow copper, or *bi-sulphuret*, is convertible into the *sulphuret* of that metal by weak voltaic action. His apparatus consisted of a trough divided into two compartments or cells, by the intervention of a mass or wall of moistened clay. In one of these cells he put a solution of sulphate of copper, and a piece of the yellow bi-sulphuret of copper; and in the other cell, some water with a little sulphuric acid in it, or water only, without acid, together with a piece of Zinc which was connected with the copper pyrites in the other cell, by means of a copper wire.

This simple voltaic arrangement quickly changed the surface of the copper ore from a yellow to a beautiful irideseent colour, afterwards to purple copper, and finally, in the course of a few days, to the sulphuret, on which metallic copper was copiously deposited in brilliant crystals. When this process was continued for some weeks, and sulphate of copper added from time to time, the sulphuret of copper formed rather a thick crust immediately under the metallic crystals, and appeared almost black and somewhat friable. He considered that the oxide of copper in the solution parted with its oxygen to a portion of the sulphur of the bi-sulphuret, thus forming sulphuric acid, which was transmitted through the clay to the Zinc in the other cell, whilst the de-oxydized copper was deposited on the electro-negative copper ore. These results seemed to explain the reason why metallic copper is found in the mines in contact with the sulphuret and black copper ore, and not with the yellow bi-sulphuret of that metal; and likewise

why the sulphuret of copper commonly occurs in metallic veins nearer the surface than the yellow bi-sulphuret, where it is exposed to the action of water and of ferruginous matter, as indicated by the "*gossan*," or oxide of Iron, which occurs in the upper regions of Copper mines in Cornwall. Mr. R. W. Fox referred also to his experiments on the electro-magnetic condition of metallic veins, and adduced proofs of the electricity which he had detected in them, being independent of accidental influence; indeed, he obtained very decided voltaic action when a piece of sulphuret, and another of yellow bi-sulphuret of copper were dipped in water, taken from a mine, the former being electro-positive with respect to the latter. This experiment shows that the voltaic action between different metallic lodes, and different parts of the same lode, must be very great. He was induced to commence his electro-magnetic experiments in mines in consequence of the analogy which he thought he perceived in mineral veins to voltaic combinations.

In another experiment Mr. R. W. Fox has substituted the sulphuret or vitreous copper ore for the piece of Zinc in one of the cells, all other circumstances being the same as before described, and in a few weeks the yellow bi-sulphuret of copper in the other cell was covered with a thin coating of the sulphuret of that metal. He has also found that sulphuretted hydrogen is copiously evolved when yellow copper ore is placed in a solution of sulphate of Zinc or of Iron in one of the cells, and connected, by means of a wire, with a pieee of Zinc in the water of the other cell. As sulphuretted hydrogen has the property of precipitating most of the metals from their solutions, in the form of sulphurets, this experiment seems to point at an agent which may have produced many of the metallic sulphurets. See vol. ii. P. 108. Note.

In a subsequent communication to the Geol. Soc. of London, January, 1837, Mr. Fox observes, "I imagine that I see more and more reason to believe, that the Eastward and Westward tendency of metallic veins, must be ascribed to the electro-magnetic influence of the earth. In some parts of the world there may be considerable deviations from this bearing, which may be owing to local circumstances; but the coincidence in their direction, generally speaking, is so great and decided as clearly to indicate

the operation of a general law. It is worthy of remark that many of the large veins of hæmatite, and other varieties of the oxide of iron found in Cornwall, have nearly a N. & S. bearing. I am not prepared to say whether there are any exceptions, or not; but it is curious to find decided iron veins nearly coincident with the mean magnetic meridian."

M. Becquerel has recently made a most important application of some electro-chemical apparatus, to the immediate reduction of the ores of silver, lead, and copper, without the intervention of mercury, and is now occupied with further researches on the extraction of metals from their respective ores. L'Institut. March 21, 1836. Phil. Mag. February, 1837.

The practical results of these researches are noticed in the following terms by Mr. Wheatstone, in a letter I have recently received from him upon this subject. "The value of Mr. Fox's interesting experiments consists in the exact analogy they bear to the circumstances which actually take place in mineral veins; still more important are the long-continued researches of M. Becquerel, on the permanent action of feeble currents in effecting chemical combinations and decompositions; a very full account of these instructive experiments has recently been published in the the third part of Taylor's Scientific Memoirs, and deserves the attention of every geologist who desires to penetrate into the mysteries of mineral formations. Neither are these investigations without practical value; M. Becquerel has recently shown a mode by which the precious metals may be separated from their ores, in a perfectly pure state, without the aid of mercury; and we understand that the process is now actually working in some of the mining establishments of France. The electro-chemical apparatus for this purpose, consists simply of iron, a concentrated solution of sea salt, and the ore of the metal properly prepared. Thus that mighty agent, which nature has hitherto exclusively employed in her extensive laboratory, is beginning to be the obedient servant of man; and it requires not the tongue of a prophet to foretel that the voltaic pile will hereafter create as great a revolution in our chemical manufactories, as the steam-engine has already effected in the mechanical arts."

APPENDIX.

P. 73, l. 25. I learn from Mr. Pentland, that the head of a species of Dasyurus as large as, and closely allied to, D. Cynocephalus (Thylacinus Harrisii) of Van Diemen's Land, has been recently discovered in the Eocene Fresh-water limestone of Auvergne. The Thylacinus is the largest of the carnivorous marsupial animals, being of the size of a wolf, but having shorter legs; it is the only living species of this genus, and is found only in Van Diemen's Land.

P. 166, Note. In the Tertiary formations we have fossil frogs, tadpoles, and salamanders, in the Papier Kohle near Bonn (see P. 509, Note, and P. 514, Note, l. 26), and fossil Snakes in the Fresh-water strata of Clermont, in Auvergne.

P. 331. It is shown in a notice read by M. Voltz to the Natural History Society at Strasbourg, December 6, 1836, that the problematical fossils known by the name of Aptychus, Trigonellites, &c. which are sometimes found lodged in pairs within the first chamber of Ammonites, were Opercula connected with the foot, or organ by which the animals inhabiting these shells moved along the bottom of the sea. (L'Institut, February 8, 1837.) The form of the dense coriaceous foot of the Pearly Nautilus figured by Mr. Owen in his Plate 3, Fig. 1, (See our Supp. Note, P. 608), resembles that of the valves of several species of Aptychus; but it has no shelly appendage.

P. 473, l. 27. Further important communications respecting Sigillaria have recently been published in the 11th and 12th Livraisons of M. Adolphe Brongniart's Végétaux Fossiles, 1836; in the details of which he points out the relations of these abundant and curious fossil plants of the coal formation to arborescent Ferns, in a manner that justifies the place he originally assigned to them in the family of Ferns.

END OF VOL. I.

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2

1/16th

Restoration of Dinotherium, see p. 603.

2. Head of Dinotherium gigantcum found at Epplesheim in 1836. See Sup. Note, p. 603.